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The Engineering Works and Natural Resources of The City of Calgary and the Bow River Valley of Alberta.

Presented to
The Members of the National Engineering Societies of America
returning from
The International Engineering Congress

With the Compliments of the City of Calgary and the Engineers of Alberta
October, 1915

Foreword

THIS Pamphlet is issued through the courtesy of

The City of Calgary;

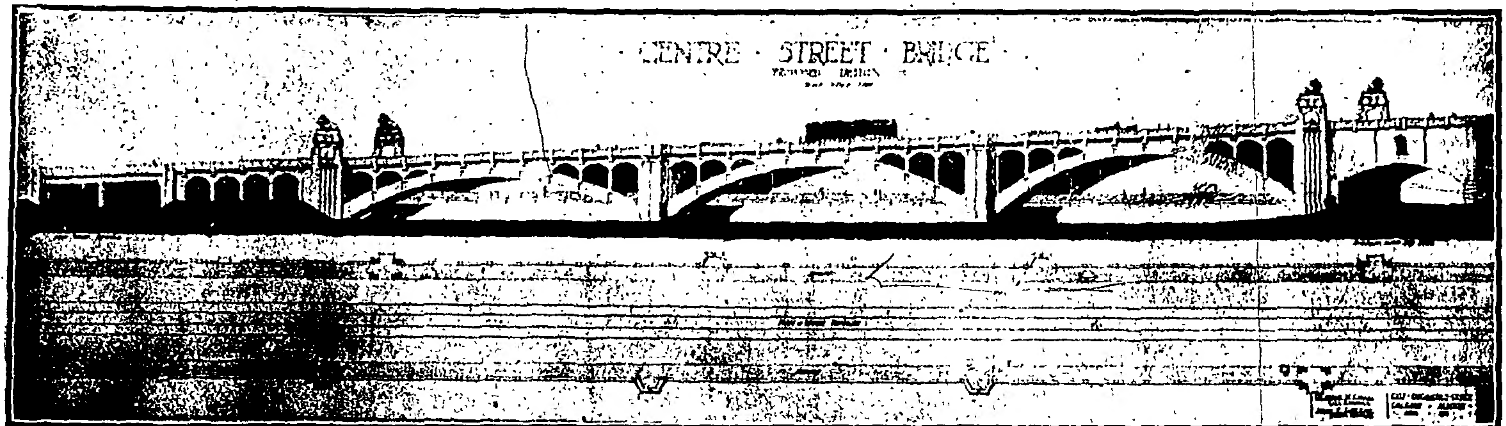
The Canadian Pacific Railway Company;

The Calgary Power Company;

The Calgary Branch of the Canadian Society of Civil Engineers and Other members of the Civil, Mining, Mechanical and Electrical Engineering Professions in Alberta.

A most hearty welcome is extended to the Members of the National Engineering Societies of America and their guests, who have honoured us by paying a visit to our Province.

Some of the many features of engineering interest are briefly described in the following pages. It is regretted that full justice cannot be done to our many valuable resources in these few pages. It is hoped, however, that this brief description, together with the all too short visit you may be able to make to some of the points of interest, will add something to the pleasure and profit of your trip and induce you to a better acquaintance with the resources of Western Canada, which are open to development through the efforts of Engineers.



The Centre Street Bridge, Bow River, Calgary
(NOW UNDER CONSTRUCTION)

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THE CITY OF CALGARY

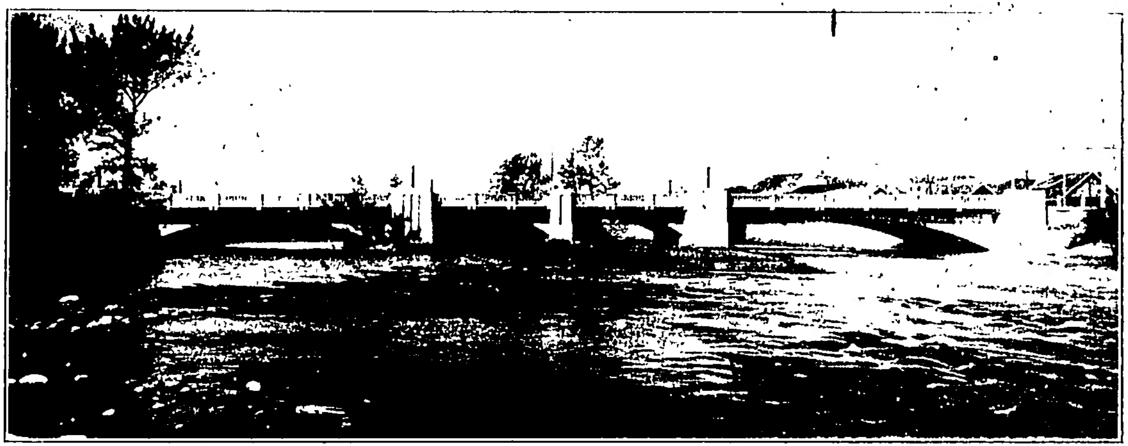
and its MUNICIPAL ENTERPRISES

Compiled by R. C. GILLESPIE, Esq.
Under the direction of G. W. CRAIG, M. Am. Soc. C.E., City Engineer, Calgary

The City of Calgary was so named in 1876 by Colonel MacLeod then commanding the detachment of the Royal North West Mounted Police at this point. He named it after his old home, a small estate on the Isle of Mull, Scotland. "Calgary". is said to mean "running water".

In 1875 the first detachment of the Mounted Police arrived under the command of Captain Brisebois, who built Fort Brisebois near the site of the present Grand Trunk Pacific Railway depot. Around this point was formed the first white settlement, and the Hudson's Bay Company opened the first trading post here. Colonel MacLeod took command of the post in 1876, renaming it Calgary. In 1884 the "Town of Calgary" was incorporated, with an area of 1600 acres and a population of 506, the first Mayor being George Murdoch. In 1886 the first train from Montreal to the Pacific Coast passed through Calgary. In 1891 the Calgary & Edmonton branch of the Canadian Pacific Railway was put in operation. In 1893 the Macleod branch of the C.P.R. started operation. In 1900 the City purchased and started to operate the Calgary Gas & Water Works. In 1904 the C.P.R. Irrigation works started just East of Calgary. In 1907 the Gravity system of water supply was installed. In 1908 the Municipal Street Railway started construction. In 1909 the Commission form of civic government was introduced. In 1914 the first Grand Trunk Pacific and Canadian Northern trains arrived in the City. In 1915 the population of the City is estimated at 80,000, and the area of the City is 40½ square miles.

The development of Calgary from the "cow town" of early days to its present eminence as the business centre of the Province of Alberta, and the largest and most important city between Winnipeg and Vancouver, has been exceptionally rapid and typical of the development of the Canadian North West. A great factor in this development is the geographical position of the City. On the junction of two rivers, the Bow and the Elbow, its proximity to the Rockies, access to the untold wealth of natural resources of the Province, and an ample supply of excellent water, all contribute towards making the City one of the most important places in the North West. Instancing Calgary's wonderful growth it is worthy of note that in 1884 the date of incorporation as a Town, the population was 506. In 1894. the date of incorporation as a City, the population was a little over 5,000. In 1904, 10,543, and in 1914, 80,000.



The Mission Bridge, Elbow River, Calgary

Calgary is governed under a somewhat unique form of Commission Government. This form had its inception, so far as Calgary is concerned, in 1907, the Commission then consisting of the Mayor, City Clerk and City Engineer, appointed by the Council. After a brief trial this Board was found to be unsatisfactory, and was supplanted by a Commission consisting of the Mayor as Chairman, and two Commissioners. The Board is an elective one, the Mayor being elected yearly, and the two Commissioners for two years, one retiring each year. The present method of distribution of the various civic departments under the Commission is as follows:—

Mayor. Finance, Fire, Police, and General Executive.

Commissioner of Public Utilities. Street Railway, Waterworks, Electric Light and Power, Market.

Commissioner of Public Works. Engineer, Paving, Grading, Sewers, Streets, Parks, Public Works and Buildings.

The Council consists of 12 Aldermen and the Mayor as Chairman. The Aldermen are elected for a two year term of office, six retiring each year. The qualification for office is a property qualification, and the Aldermen receive no remuneration.

It will no doubt be of interest to hear something of the City of Calgarys' civic utilities and undertakings. The City is one of the foremost in the ranks of civic owned and operated utilities. The Waterworks system, Electric Light and Power, Street Railway, Paving Plant, Market, Sewage system, Parks system, Stores and Purchasing Agent and Incinerator, in addition to all the usual executive offices are all owned and operated by the Municipality, and it is thoroughly recognised that the results obtained fully justify the system of operation.

STREET RAILWAY

In the Street Railway system Calgary has 71½ miles of track, [illegible] miles being upon paved roads, and there are 65 cars in operation. The service has shown a surplus in every year since the commencement of operation in 1909. The capitalization of the system in Debentures of the City is approximately Two and one-third Million including paving costs. Power is supplied by two 500 K.W. direct driven steam units and one 1,500 K.W. motor generator at the central Power Station, and two additional sub-stations are under construction which will increase the power by 1,200 K.W. hours.

Statistics

Year	1910	1911	1912	1913	1914
Passengers carried ...	3,649,697	7,176,086	12,941,630	16,986,658	16,213,731
Miles operated	500,622	801,086	1,643,328	2,648,234	3,112,407
Surplus	$29,435.53	87,206.64	107,253.49	69,492.82	3,831.60
Cars operated	15	22	48	65	65
Miles of track	16½	26½	54	70½	71½
Number of employees ..	62	102	246	348	380

WATERWORKS

Calgary obtains its water supply from the neighbouring Bow and Elbow Rivers, pumping same from the Bow and obtaining a supply from the Elbow by a gravity pipe line. The intake on the gravity line on the Elbow is located about 13 miles west of the City, and the line furnishes a supply of Eight Million gallons per 24 hours. The level at the intake is approximately 300 feet above the general level of the centre of the city. At the west end of the City on the Gravity line is a reservoir of Sixteen Million gallons capacity. At the present time plans are being prepared to increase the capacity of the gravity system by an additional Five Million gallons per 24 hours, by extensions and improvements at the intake, and to increase the storage capacity of the reservoir by approximately Sixteen Million gallons. The supply from the Bow River is obtained by pumping, the new pumping station at Twenty-First Street West having a capacity of Twenty Million gallons per 24 hours. The higher levels of the City are dealt with separately, water being pumped into an elevated storage tank and distributed over that district.

At the present time there are 190.32 miles of water mains in operation in the City and 13 miles of 30-inch wood stave pipe in the gravity line. There are 9,879 connections, 1,027 hydrants, 140 public water taps and 12 public water troughs. A pressure of 85 pounds per square inch is maintained in the mains, which with the aid of the pumps can be materially increased in times of emergency.

SEWERS

In the sewer system of Calgary there are 201.43 miles of sewer, including about 30 miles of trunk sewers. There are 8,880 connections, 1,974 manholes and 1,186 catch basins. Until recently the outfall was into the rivers, but all the outfalls are now being picked up and centralised to the site of the proposed Sewage Disposal Plant. A site for the plant has been purchased on the banks of the Bow River on the southeasterly limits of the City at Bonnybrook. The particular style of sewage disposal plant has not yet been fully decided upon, but investigations are being made along the lines of a plant of the activated sludge type.

In order to connect the North side of the Bow River with the direct trunk sewer to the disposal plant, a reinforced concrete tunnel has been driven under the river at Fifteenth Street East. The tunnel is 958 feet long, and there passes through it an inverted syphon consisting of three pipes of 20, 24 and 33 inches diameter, with a capacity of approximately 50 cubic feet per second. This will take care of all the sewage from the North side and convey same to the disposal plant for treatment.

It will be interesting to note that during the past winter construction was started—as relief work—on the Nose Creek Trunk sewer. Constructing a concrete sewer in winter was an innovation, but with proper safeguards a very satisfactory job was performed at a reasonable cost, and no concrete was lost through frost.

STREETS

Calgary is one of the best paved cities in the West, having 61.69 miles of pavement of various kinds, Wood Block, Granitoid, Bitulithic, Asphaltic Concrete and Sheet Asphalt. In former days pavement was laid by Contractors, but in 1912 the Civic Authorities inaugurated the Municipal Paving Plant. This step has been fully justified, for since commencing operations the Plant has laid a large amount of Asphaltic Concrete pavement at a less cost than previously. A summary of the operations of the Department follows:—

Year	1912	1913	1914
Sq. yds. A. C. pavement	30,233.7	132,424.0	140,252.7
Extra A. C. surface	7,455.1	———	6,279.3
Lin. ft. curbs and gutters	29,908.5	60,869.2	69,857.9
Sq. ft. sidewalk	2,539.0	4,818.1	472,693.2
Cu. yds. retaining wall	50.0	175.0	75.0
Sq. yds. concrete pavement	———	5,063.0	888.3
Sq. yds. stone pavement	———	10,504.9	4,027.9
Sq. yds. brick pavement	———	———	745.0
Lin. ft. concrete header	———	4,610.0	14,327.7
Lin. ft. sub-base under Street Railway, single track	———	32,284.6	25,079.3
Cost per sq. yd. A. C. pavement	$2.02	$1.89	$1.85
Total expenditure for all work	$71,709.13	$419,362.91	$579,771.97

In addition to the above the Municipal Plant performed all repairs to cuts in pavements.

The permanent improvements to streets are as follows:—

Miles of pavement	61.69
Miles of concrete walk	160.65
Miles of curb and gutter	69.61
Miles of heavy curb	4.35
Miles of streets graded	109.41
Miles of streets boulevarded	47.11
Miles of conduits laid—	
Trench miles	20.68
Duct miles	116.80

BUILDINGS

Calgary has some fine buildings and the City Hall is the most modern west of Toronto. Some of the most prominent structures in the City are the Palliser Hotel, Herald Building, Canada Life Building, Hudson's Bay Building, Public Library, Grain Exchange and Knox Church, while the Public Schools are acknowledged to be the finest in the West. Instancing the remarkable growth of building in Calgary, the following tabulation indicates the progress year by year:—

Year	No. of Permits	Building Expenditures
1908	1,028	$ 5,914,942
1909	777	2,420,450
1910	1,499	5,589,594
1911	2,619	12,907,638
1912	3,483	20,394,220
1913	2,078	8,619,653
1914	1,255	3,425,350

BRIDGES

Spanning the Bow and Elbow Rivers are eight steel bridges and one concrete bridge, whilst a high and low level concrete bridge is now under construction. These are all traffic bridges and do not include the numerous railroad bridges built by the three transcontinental lines. Special mention may be called to the new Mission Bridge across the Elbow River at Fourth Street West, and the Centre Street Bridge.

The Mission Bridge is a reinforced concrete bridge built in a style which closely harmonises with its name. It has four spans, one 86 feet, one 76 feet and two 34 feet wide. The roadway is 40 feet wide and there is a 6-foot walk on either side, while the width of the bridge over the abutments is 60 feet. The cost of this bridge was $48,000.00.

At Centre Street construction has started on the new bridge. When complete it will be one of the most imposing structures in the West. The design is for a high level bridge of reinforced concrete, with a suspended low level bridge. The bridge will consist of a series of arches, three main spans each 150 feet long, crossing the river; a 62-foot span crossing a boulevard on the North side of the river, and a series of short spans at the South end, with a retaining wall approach. The grade from the South to the North side will be 3.85 per cent, and the width of the roadway will be 42 feet to admit of street car and vehicular traffic, while a 7-foot walk on either side will carry the pedestrian traffic. The suspended low level bridge will have a width of 18 feet. The height of the retaining wall on the North side of the river is 50 feet, and the hill behind will be graded to correspond with the grade of the bridge. On the abutments four towers will rise to a height of 18 feet above the bridge and be surmounted with a statue of a lion on each tower. The estimated cost of this bridge is $375,000.00 and it is expected that it will be completed by the end of 1916.

CALGARY'S GROWTH BY STATISTICS

Assessments

Year	Assessment
1885	$ 386,863
1895	2,076,530
1905	5,433,469
1914	134,886,425

Population

Year	No.	Year	No.
1884	506	1909	35,000
1901	6,557	1910	50,000
1904	10,543	1911	55,000
1905	12,500	1912	70,000
1906	17,000	1913	85,000
1907	21,040	1914	80,000
1908	25,000		

Voters' List

Year	No.	Year	No.
1907	6,278	1911	17,006
1908	6,972	1912	23,736
1909	8,996	1913	33,875
1910	11,504	1914	38,472

THE OGDEN SHOPS

In 1913 the Canadian Pacific Railway Company completed their locomotive and car shops at Ogden, four and one-half miles east of Calgary. They rank among the largest, most modern and completely equipped shops on the continent.

Most of the buildings have steel frames and roof trusses, concrete foundations and brick or concrete walls. Many of them have wooden roofs of slow burning mill construction waterproofed with felt, tar and gravel.

Machine tools are operated by electricity. Both mercury vapor and incandescent lights are used. Steam for heating and other purposes is provided in three batteries, each having two 350-hp. boilers. Five of the boilers are provided with chain-grate stokers and one with a shaking grate for burning planing mill refuse.

The main locomotive shop is 778 feet long and includes the erection, machine, blacksmith and boiler shops. A 120-ton travelling crane furnished with two 60-ton trolley hoists is used for handling locomotives. Travelling cranes, trolley hoists and jib-cranes of capacities varying from 3 tons to 25 tons serve the various machines and transfer materials as required.

The freight car repair shop contains eight repair tracks placed in pairs, with an industrial track between each pair.

Among other buildings are the foundry, the wheel shop, planing mill, pattern shop, carriage repair and paint shop, oil house, boiler house, storehouse and office building.

GOVERNMENT ELEVATOR

By C. D. Howe, Chief Engineer, Board of Grain Commissioners of Canada

The Canadian Government Elevator at Calgary is a reinforced concrete terminal elevator of 2,500,000 bushels capacity. This interior terminal elevator, together with similar elevators of 3,500,000 bushels capacity each at Moose Jaw, Sask., and Saskatoon, Sask., were constructed by the Board of Grain Commissioners for Canada to operate in connection with the Boards' Lake terminal elevator at Port Arthur, Ont., and with the Board's Ocean terminals at Vancouver, B. C., and at Port Nelson, Hudson Bay, which two last mentioned elevators are now under construction. The purpose of the Calgary elevator is to provide storage

and cleaning and drying facilities for grain grown in the Province of Alberta, and to act as a reservoir for shipments eastward via the Great Lakes, or more especially for shipments Westward to Vancouver.

The Calgary elevator is of fireproof construction throughout and consists of a working house of 500,000 bushels capacity, and a storage annex of 2,000,000 bushels capacity. The receiving capacity is 18 cars of grain per hour, and the loading out capacity 36 cars per hour.

The drying plant has ample capacity for drying 24 cars of grain per day, and the sacking plant, a sacking capacity of 20 cars per day.

The elevator is electrically driven, power being supplied by the City of Calgary at 12,000 volts, and reduced in the elevator substation to 550 volts for power purposes, and 110 volts for lighting. A separate motor drives each machine. A cyclone dust collector system and a compressed air system are included in the equipment.

The Elevator is especially well equipped for cleaning grain, its cleaning equipment consisting of ten receiving separators, two flax separators, two wheat and oat separators, and a screenings separator. These machines are all of large capacity, and the equipment provides for all ordinary grain separations, as well as for cleaning seed grain. A screenings grinder of large capacity is installed to chop elevator screenings for feed purposes.

All grain is weighed on hopper scales located in the working house cupola, six scales of 2,000 bushels capacity each being installed. Two automatic sacking scales are included in the elevator equipment. A boiler house containing two 100 H.P. Marine type boilers furnishes steam for drying grain.

The elevator is connected by direct spur trackage to the Canadian Pacific and the Canadian Northern Railroads, and by a transfer connection to the Grand Trunk Pacific Railroad. Ample trackage for loading and unloading and sorting cars is provided at the Elevator site.

The total cost of the Calgary elevator is approximately one million dollars. Janse Bros., Boomer, Hughes and Crain were the general contractors, and the engineering staff of the Grain Commissioners were the Engineers.

CATTLE, HOGS AND PACKING HOUSES

By F. M. Black

It was as a cattle raising country that Alberta first obtained attention, and came prominently before the world. The heavy growth of wild grasses on its plains and uplands, and its comparatively mild winters, with light snowfalls, have made it an ideal feeding ground for cattle all the year round, since it is possible to let herds of cattle "rustle" for themselves in winter, without any shelter whatsoever.

These earlier conditions continued until the later nineties, when it was definitely found that not only would Alberta grow wheat, but GOOD wheat, and plenty of it. From these years, began the settlement of

farmers which has been so noticeable, and which has marked the changing of the province from a country of ranchers and cowboys, to a country of farmers.

Many farmers have hitherto confined their attention to grain growing alone, but a succession of indifferent years, during which crops were, from various causes, below the average, has demonstrated that farming in order to be successful in Alberta, must be "mixed", i.e. must include the care of all kinds of livestock—cattle, hogs, sheep and fowl.

In consequence, while cattle today are not found in such large herds, there are probably many more in the country than in the old days. These receive more attention, and they are no longer expected to find winter subsistence for themselves, but are fed from stacks of hay, and in many cases, with grain.

The production of hogs has been very variable, but has been steadily on the increase throughout the last three or four years, the increase in one year being as much as 300 per cent. Prices have been satisfactory and encouraging to the grower, although the extremely high price of grain in the close of 1914, rather operated against the industry.

The marketing of cattle and hogs has led to the establishment of the packing industry, which today, is probably the most important secondary industry operating in the Province of Alberta. The pioneer of this business has been Mr. Patrick Burns, who commenced operations in the Province about the year 1892, establishing a business which looked to the supplying of British Columbia with live cattle, and later, with dressed meats.

The nucleus of the present extensive plant of P. Burns & Co., Ltd., which stands in East Calgary, was built about the year 1896, and its growth has been steady ever since. Today, the abattoir and cold storage buildings are amongst the most modern on the Continent of America. A disastrous fire in January, 1913, removed several of the older erections, and in rebuilding operations, the latest ideas in packing house construction were incorporated.

The growth and development of the West during the past ten years, also attracted the attention of Messrs. Swift & Co., packers of Chicago, who during that period have built a packing house at Edmonton, and have opened subsidiary depots on the Pacific Coast.

Great though the progress of the past few years has been, the development which lies ahead will be still greater. Live stock must be the mainstay of the country, and with its increase, must come development of all industries, directly or remotely connected with its marketing.

The IRRIGATION WORKS *of the* CANADIAN PACIFIC RAILWAY COMPANY

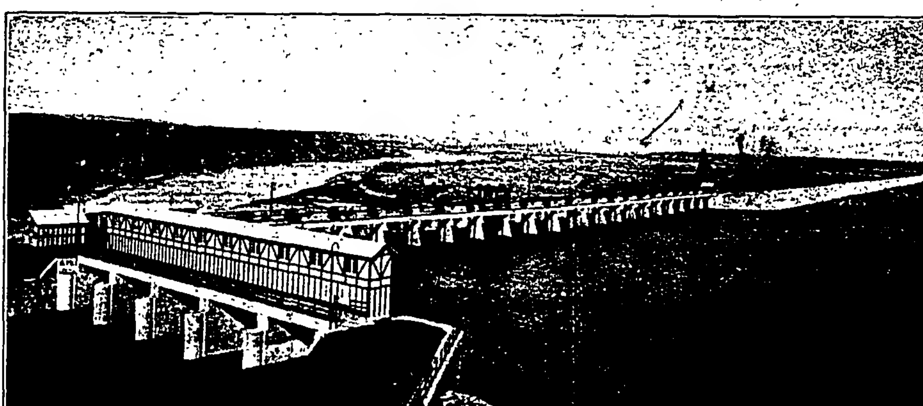
By H. B. MUCKLESTON, M. Am. Soc. C.E., M. Can. Soc. C.E.
Department Natural Resources, Canadian Pacific Railway Co.

Diversion Dam at the Calgary Intake to the Western Section

The Main Canal supplying water to the Western Section of the C.P.R. Irrigation Block, takes out of the Bow River within the limits of the City of Calgary.

The first structure built at this point consisted of a wooden headgate without any diversion weir. It was considered that during the life of this structure the demand for water would be such that the necessary quantity could enter the canal without requiring any diversion weir in the river. And this expectation was fully realised.

Where the canal leaves the river, its normal depth at full supply level is calculated to be about ten feet. The sill at the headgates was originally placed at the same elevation as the deepest point in the river, immediately opposite, thus requiring a depth of at least ten feet in the river. This depth is never attained in normal conditions and seldom under the most extreme flood. It was therefore necessary to provide a diversion dam across the river in order to insure a sufficient depth of water at all stages of the stream. However, owing to the flashy character of the stream itself, and to the fact that the structure would be built



The Bassano Dam, Eastern Section C.P.R. Irrigation Block

in the middle of a large and growing city, it was a self evident fact that any dam built across the stream must be of such a type that it could be, to all intents and purposes, absolutely removed in times of flood; otherwise the damage caused by the backwater would be extreme.

It was decided there must be provided one clear opening adjacent to the North bank at least 150 feet wide, with no permanent obstruction across it nearer to the river surface than 20 feet. It was also decided that whatever closure was used for the balance of the structure, must be capable of being operated by one man. These requirements have been met, first as regards the 150 feet opening, by a beartrap dam designed after those in use at the Chicago Drainage Canal.

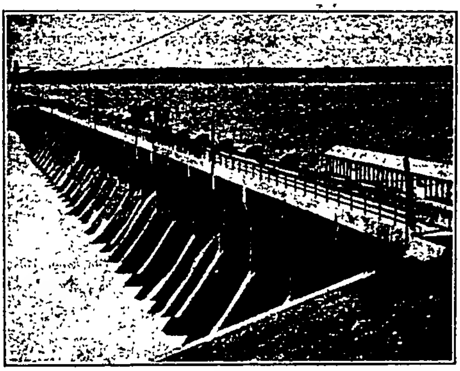
As to the balance of the structure, it was thought that a stop log dam similar to that above Chaudiere Falls in the City of Ottawa, would best meet all requirements.

The new structure therefore, consists of four parts:—

First, the new intake or headgate structure, which consists of four openings, each twenty feet in the clear, closed by Stoney gates working on live rollers and provided with an upstream groove for emergency closures by stop logs. The logs serve the further purpose of protecting the gates themselves from damage by ice shoves during the winter, which are sometimes severe at this point of the river.

The headgates are counter weighted to 90 per cent. of their unimmersed weight, and the machinery is arranged for either power or manual operation.

The beartrap opening is 152 feet clear between side walls and is located immediately south of the north bank of the river. It is of the sector type and is controlled by a moveable annular weir.



The Bassano Dam. Eastern Section
C.P.R. Irrigation Block

The stop log portion consists of twenty-three openings, each of which is twenty feet in the clear and is situated immediately south of the bear trap section. The floor of the section is not a constant level throughout, but is stepped up at intervals, in order to follow the original cross section of the bottom of the stream.

The openings are closed by logs of Douglas fir 12 inches by 18 inches, and 22 feet long. The logs are handled by a machine which has the three motions of the ordinary travelling crane. The operator is therefore able, without leaving his seat on the machine, to engage the log and hoist it out of the groove and stack it on the bridge, and when sufficiently expert in handling the machines, the operator can work the logs at the rate of one per minute.

Immediately south of the stop log portion, a breeching section has been constructed. This was built with the intention that should the stop log portion of the dam become inoperative through jams of logs and

drift, the breeching section may be broken and thus prevent backing up of the water above the dam.

The Contractors for the masonry portion of the structure were:—

Messrs. Hayden & Skene, and Messrs. Janse Bros., Boomer & Hughes, both of Calgary.

Headgates, machinery and stop log machine were built by the Canadian Allis-Chalmers Co., of Toronto.

Beartrap, overhead bridge and machinery by the Chicago Bridge & Iron Works.

HORSE SHOE BEND DAM, BASSANO

The intake for the canal system which serves the Eastern Section of the Irrigation Block, is located at the Bow River, about four miles S.W. of the Town of Bassano. At this point an old river channel cuts across the country from the BowRiver to the Red Deer which has been eroded to such an extent that at its highest point, which is the height of land between the Bow River and Red Deer, it was only ninety feet higher than the bed of the former stream. It therefore, made an excellent site at which to divert water from the river for the irrigation of the Eastern Section, provided it was possible to construct a dam across the valley of the river, which would raise the surface about fifty feet.

The structure as a whole consists of two parts, or, including headgates, three. The headgates themselves are very similar to those at the Calgary intake, but are on a larger scale as the quantity to be diverted is much greater.

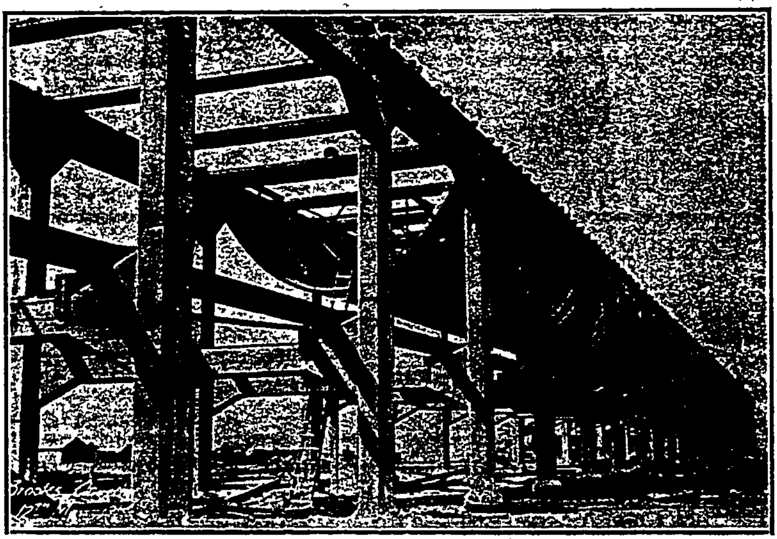
The Dam consists of a reinforced concrete spillway structure, across the bed of the Bow River, and an earthen embankment keeping a middle line between the heels of the horseshoe. The concrete spillway is 720 feet long between abutments and the earthen embankment, 7,200 feet long measured from the Western abutment of the spillway to its extreme western end.

The spillway consists of an Ambursen Dam approximately forty feet high on top of which are provided twenty-four sluice gates, each of which is 27 feet wide in the clear and may retain 11 feet of water. Below the spillway, a concrete carpet or floor is provided, 90 feet wide, on which the energy due to the fall can exhaust itself without scouring the bed of the stream. In order to assist in this process, a series of baffle piers have been built all the way across the structure at the foot of the overfall, and as further protection against scour, a floating apron has been provided at the extremity of the concrete carpet.

The earthen embankment was constructed of material from the canal cut, which was hauled across by a locomotive and train and spread by 4-horse Fresno scrapers working across the embankment. The wet face of the embankment is paved with 6-inch concrete slab, resting on a 9-inch gravel cushion. The foot of the paving is provided with a deep concrete curb pierced with weep holes, and at the crest, a parapet wall with an

elliptical section is provided to prevent wave wash from going over the structure. Although the longest possible fetch for any waves on the pool above, the dam is not more than three-quarters of a mile, allowance was made in design for a possible wave 8 feet high from trough to crest.

The concrete spillway is founded on a thick bed of tough blue clay, which underlies a few feet thicknesses of gravel, forming the actual bed of the river. Under this embankment of clay which is about 20 feet thick, the borings showed a water bearing sand. It was found that the water in this stratum was under a pressure about three feet greater than the actual level of the river at this point. It was also found that the clay blanket disappeared about three thousand feet upstream which would correspond to a fall of about three feet in the river surface, and it was feared that this excess was due to the sand stratum being exposed upstream from the dam and that there was a possibility when the additional fifty feet head was placed above this point, that a corresponding pressure would develop in the stratum underneath the dam. Measures



The Brooks Aqueduct, Eastern Section C.P.R. Irrigation Block.

were therefore taken to relieve any possible excess of pressure by boring a series of six inch steel cased holes through the clay into the sand stratum. After the dam was closed, it was found that the water rose in these casings but by no means enough to correspond to the increased head, and in no two of these, to the same elevation.

In order to provide for rapid operation of the canal and sluice gates, a power plant was installed as a part of the structure, and advantage is taken of this power plant to light the interior of the dam and to provide arc lights along the exterior bridge, and to light and pump water for the various buildings occupied by the attendants.

BROOKS AQUEDUCT.

The Brooks Aqueduct serves the purpose of conveying some 900 cubic feet of water per second, across a valley two miles in width, and this furnishes irrigation to a large extent of territory, which without it could not have been served. The structure is probably the only one of its kind in existence, and it is therefore likely that a fuller account of this development will be of interest.

Those who are sufficiently interested to follow the matter, will find an account in the "Engineering News" for the issue of July 8th, 1915, and also in "Engineering," a London paper published on April 23rd.

The structure itself consists of a reinforced concrete trestle, carrying a suspended shell of reinforced concrete. This suspended type of flume is not unique in itself as it is a familiar construction in steel. Novelty in this particular structure is the curve adopted for the shell. Hitherto, suspended flumes have been invariably circular in section probably from reasons connected with manufacture. The circular curve, while convenient is not the correct curve. which is the curve that a flexible sheet would assume under the liquid load. This curve is called the Hydrostatic catenary, or elastic curve. It is one of the forms which a straight spring would assume, when its ends are acted upon by two opposite forces in the same straight line. An example would be the archers bow, if it were made of uniform section throughout, where the bow spring represents the line of action of the forces.

The hydraulic properties of this section can be very easily investigated by means of a piece of clock spring and a planimeter. The mechanical properties of the curve can only be worked out by a series of approximations as the curve of equilibrium under a hydrostatic load. Tension in the shell must be uniform throughout, and there can be neither moment nor shear at any point when the flume is full. At partial loads. both moment and shear exist but are extremely small in amount and sufficient stiffness in the shell is secured when the concrete is thick enough to contain the desired quantity of reinforcement.

It has sometimes been questioned as to why an elevated structure of this type was built. The reason is two-fold. First, because it was cheaper; secondly, because inverted siphons where the water carries any quantity of silt are extremely hard to operate, unless carrying always full supply, otherwise the pipe must be blown off at periodical intervals, in order to prevent the pipe from being blocked up by deposits. This blowing off process assumes very serious proportions in a pipe as large as would have been necessary at this point, and of such a great length.

The structure is 10,480 feet long and at its maximum heaight is 64 feet from foundation to top of girders.

Water Power Resources of Canada

By J. B. Challies, Superintendent Water Power Branch Department of the Interior, Dominion of Canada.

Within the provinces of the Dominion of Canada and excluding the Northwest Territories, practically all of the Yukon, and the Northern and Eastern portion of Quebec, it is estimated that 17,764,000 horse power

is available, this amount being inclusive, in the case of Niagara Falls, Fort Frances and the St. Mary's River at Sault Ste. Marie, of only the development permitted by International treaties, and further does not contemplate the full possibilities of storage for the improvement of capacities. The developed powers which are inclusive of all water powers whether for electrical production, pulp grinders, for milling or for the great many other uses, aggregate 1,711,188 horse power.

The Prairie Provinces are essentially agricultural. Red Fife and Marquis are names to be conjured with in the wheat markets of the world. The deep, rich prairie soil is a mine available to hundreds of thousands of farmers whose dividend of golden grain is never failing. The settlement of the great west has been fabulously rapid and the industrial development has far from kept pace with the agricultural requirements; the industrial era has, however, dawned, and it is to be expected that in the near future the local consuming market will be to a great extent satisfied by local manufacturers.

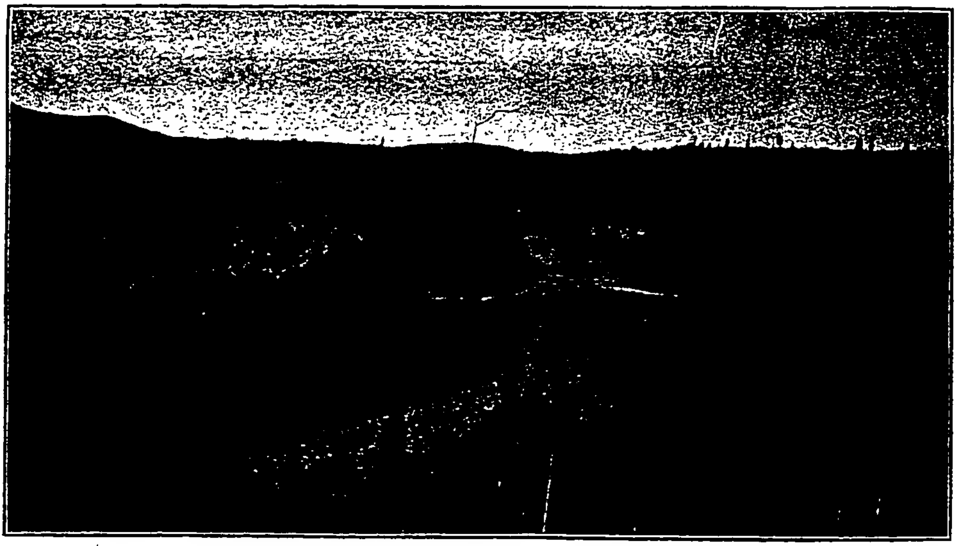
Kananaskis Falls, Bow River.

The uses of electric power in an agricultural country are threefoll: first, directly applied to the production, operation and marketing of the products and natural resources; second, for manufacturing purposes in the supplying of the market created by the people of such a country: and third, in the community life, the public utilities and transportation.

It is hard to predict the future of electric power under such conditions. The enormous strides of the last twenty years, in reality the period since the establishment of the first commercial electrical transmission system, has developed established loads necessitating in the United States and Canada, alone, the development of water power plants aggregating nearly ten million horse power, the last ten years more

than doubling the first ten years in the rate of growth. The load curves showing the growth in power requirements from year to year in each of the large cities of Canada show an increase from very small dimensions of from five to ten years ago to enormous demands, and at a rate of doubling in from one to three years, and with the curve of the load diagram indicating most vigorously similar increases in the years to come. While it is quite apparent that the greatest portion of these loads is consumed in the older districts of the Great West, the population and the quantity of output is, too, increasing very rapidly, adding a new factor of growth to the swelling power demand the combined effect of which is really borne out by the evidence of the respective records.

The water powers of Manitoba, Saskatchewan, Alberta, the Northwest Territories and the Yukon, are under control of the Dominion Government.



Bow Fort Damsite, Bow River.

The Dominion Government water power policy, as administered by the Dominion Water Power Branch of the Department of the Interior, affords every reasonable protection to the public as to rentals, periodic revisions, control of rates, limited grants, etc., and at the same time fosters legitimate private enterprise to return reasonable profits. Regulations are in force affording all possible assistance to the development of water powers which have every reasonable assurance of economic realization, and further, before the authorization is given to proceed with development, complete investigations are undertaken to prove the economic features of design, capacities and costs, and eventually supervision is carried out during construction. Proper government supervision and control of the construction and maintenance of all developments is the only safe method of intelligently initiating construction and maintaining an adequate system of river improvement for power purposes.

In the consideration of the water powers of Alberta, the Bow river system stands out pre-eminently. The rapidly increasing utilization of this river for power purposes, the power plants at present constructed and contemplated for construction, and the value of the potential water powers still owned by the Crown, has required the immediate attention of the Dominion Government as to the possibilities in each case, and these demands have resulted in exhaustive investigations. The complete report on the Bow River has been embodied into "Water Resources Papers No. 2" of the Dominion Water Power Branch.

The sources of the Bow River lie in the Rocky Mountains within as area of 3,138 square miles on the eastern slope. The river falls 2,750 feet before reaching Kananaskis Falls, 55 miles above Calgary, and from this point to Calgary a drop of 720 feet takes place. Six power sites of large dimensions are available, the Kananaskis Falls and Horse Shoe Falls, the highest of the series being now developed by the Calgary Power Company which in these two plants has a generating capacity of over 30,000 horse power which is transmitted to Calgary and to the cement mills at Exshaw.

Four sites are available for economic development on the Bow. These are the Bow Fort site, for which a head of 66 feet operating three 4400 horse power units is considered the best development by the Dominion Water Power Branch Esgineers; the Mission, to utilize a head of 47 feet on three units of 3,500 horse power; the Ghost site, also with three units of 3,500 horse power, on 50 foot head; and the Radnor site with three 3,500 horse power units at 44 feet head. All these four sites are located between the Horseshoe Falls and Calgary and are within short transmission distance of Calgary.

THE CALGARY POWER COMPANY'S PLANTS ON THE BOW RIVER

By F. J. Robertson, General Superintendent.

No. 1 Plant—Horseshoe Falls.

On Bow river, 50 miles west of Calgary. Dam and Power House completed May, 1911.

Dam of solid concrete, capable of discharging 40,000 c.f.s. Four stop long openings and four hydraulically operated sluice gates of "Stoney Style" installed, water led from forebay to power house by four steel penstocks which are fitted with "Butterfly" valves.

Head 70 feet.

Power House Equipment consists of:

Turbines—

2 Wellman Seaver Morgan Double runner horizontal, 6,000 h.p.
2 Lombard oil pressure governors.
2 Jens Orten-Boving Double runner horizontal, 3,750 h.p.
2 Jens Orten-Boving oil pressure governors.
2 Jens Orten-Boving Single runner Exciter turbines.

Generators by Canadian General Electric Company—

2-4000 K.V.A. 12,000 Volt 60 Cycles.
2-2500 K.V.A. 12,000 Volt 60 Cycles.
2- 110 V.D.C. 175 K.W. Exciters.

Transformers—

4-3000 K.V.A. 12,000-55,000 Volt. Oil insulated and water cooled.

Plant No. 2—Kananaskis Falls.

Situated 52 miles west of Calgary.

Dam of solid concrete, inspection and unwatering tunnels provided. Dam capable of discharging 46,100 c.f.s. with forebay at normal elevation.

Open canal leading water from forebay to gate-house and gate-house fitted with four "Tainter" gates.

Horseshoe Falls Plant of the Calgary Water Power Company.

Power House equipment:

Turbines—

2-5,800 H.P. Single runner vertical type turbines by Canadian Allis Chalmers.
1 Exciter turbine.

All above turbines are fitted with "Kingsbury" thrust bearing.

Generators—

2-3,750 K.V.A. 12,000 Volt 60 Cycles, by Swedish General Electric Company.
1 Motor-Generator Exciter.

No. 2 Plant is run during period of low water. At the present time No. 1 Plant is handling the entire load of the City of Calgary and is also capable of handling the load of the Cement Mill at Exshaw.

For information of a more detailed character, reference should be made to Water Resources Paper No. 2, published by Water Power Branch of Department of the Interior.

COAL MINES

Alberta is very rich in coal deposits. While a large number of mines have been developed, its resources in that direction comparatively speaking, have scarcely been touched.

Mines are being operated at Bankhead, Canmore and other points along the route followed by the visiting engineers. Only the one at Bankhead will be described in detail.

THE BANKHEAD MINE.

The Bankhead mine, the only Anthracite mine in Canada, is situated five miles east of Banff.

The coal bearing measures consisting of sandstone, shales, slates and the coal-seams are of the Kootenay series or lowest member of the Cretaceous measures. They lie in a valley running nearly North and South, between two limestone ranges which is a continuation of the Fernie, Hosmer, Michel, Elk River, Kananaskis, Canmore and Anthracite basin. The seams of which fourteen have been opened up, have a strike of N. 22 degrees W. and S. 22 degrees E., and a dip to the West of from 20 to 50 degrees. The base of the measures is a sandstone ledge from 20 to 30 feet thick, which stands out prominently the entire length of the valley.

The coal has a general analysis of:

Moisture	0.50 to	0.50
Volatile Combustion	8.00 to	9.00
Fixed Carbon	79.50 to	78.50
Ash	12.00 to	12.00
	100.00	100.00
Sulphur		0.20
B. T. U's.		13,500

The openings are by drift with cross cut tunnels to the other seams at three levels; the A, B and C levels, at elevation above tide of 4650, 4980 and 5345 respectively; the coal from the B and C levels being lowered to the A level by outside gravity inclines.

The inside and outside haulage is entirely by compressed air locomotives, of which there are six in number, varying in weight from 5 to 12 tons each. The mine cars have a capacity of two tons each.

The ventilation is maintained by a 13 ft. 6 in. Capel Fan driven by a 100 H.P. A. C. motor and a 12 ft. 0 in. Schiele Fan driven by a 50 H.P. variable speed A. C. motor.

The coal is prepared in a "Breaker" similar to those of the Anthracite Region of Pennsylvania, into Broken, Egg, Stove, Nut, Pea and Buckwheat sizes. The dust is briquetted, using coal tar pitch as a binder into briquettes weighing two ounces each.

The Briquette Plant contains two rotary presses of 15 tons capacity each per hour, and has made over 600 tons per day running day and night.

The Boiler House contains nine 150 H.P. return tubular boilers, having wide fire boxes, shaking grates, and induced draft fans to burn the smaller buckwheat sizes, a Green Economizer and exhaust and direct steam water purifiers and heaters.

The Power House contains two high pressure compressors, compressing to 1,000 lbs. for the air locomotives, one low pressure compressor, compressing to 100 lbs. for drills and inside machinery, two 150 K.W. A. C. generators for power and lighting purposes and a twin pump for water supply. All of the engines are cross over compound condensing, requiring a minimum consumption of steam.

A transmission line conveys current at 13,200 volts to Banff for lighting that place.

As the mine is situated in the Rocky Mountains Park of Canada, all of the houses and other buildings of the town are owned by the Company. The town has water works, sewers and electric lights.

About 400 men are employed inside and outside of the mine, its daily capacity is 1,200 tons of coal and 600 tons of briquettes.

The mine is operated by the Department of Natural Resources, Canadian Pacific Railway Company. It was opened up in 1904 and 1905 and up to September 1st, 1915, over 2,000,000 tons of coal have been mined and 700,000 tons of briquettes made. The Briquette Plant was built in 1907 and a second unit added in 1909.

THE PORTLAND CEMENT INDUSTRY.

Four Portland cement plants are operated in the Province of Alberta, located respectively at Exshaw, Calgary, Blairmore and Marlboro. The first three are limestone plants and the last mentioned uses marl. In Canada the different materials used are cement rock, limestone and clay, marl and clay, limestone and shale and limestone, shale and slate. There is but one place in Canada where cement rock is found and that is at Montreal. This rock is approximately the correct composition for burning and makes an ideal cement material. In Alberta, Portland cement is made from the other materials named. During the past year four mills were in operation: (1) The Exshaw mill of the Canada Cement Company, Limited; (2) The Calgary mill of the Canada Cement Company, Limited; (3) The mill of the Edmonton Portland Cement Com-

pany, Limited, located at Marlboro on the Grand Trunk Pacific Railway, west of Edmonton; (4) The mill of the Rocky Mountains Cement Company, Limited, at Blairmore, in the Crow's Nest Pass. A large mill is also in process of construction by the Canada Cement Company, Limited, at Medicine Hat, Alberta.

Exshaw Mill:—Operated by the Canada Cement Company, Limited. Located just east of Banff on the main line of the Canadian Pacific Railway. Daily capacity 3,000 barrels. This mill is operated on a combination of limestone, shale and slate. The limestone is a high grade rock running about 97 per cent. of lime carbonate. The shale and slate are also obtained in the immediate vicinity of the plant. Coal is used for burning. A special feature of this mill is its large cement storage (300,000 barrels).

Calgary Mill:—Operated by the Canada Cement Company, Limited. This mill is served by three transcontinental railway systems, C.N.R., C.P.R. and G.T.P. Rly. Daily capacity 1,500 barrels. To operate this mill shale from the town of Sandstone (22 miles distant) is used, which in the ratio of 3 to 1 gives a suitable mixture. There is no limestone in the vicinity of Calgary, the rock being brought from Exshaw and the Gap, two towns on the Calgary-Banff section of the C.P.R. That from the Gap is a soft, high grade limestone, running 97 per cent. lime carbonate and free from magnesia. Both coal and natural gas are used for burning.

Medicine Hat Mill:—In course of construction by the Canada Cement Company, Limited. Will have a capacity of 3,000 barrels per day; semi wet process; natural gas will be used for burning. An excellent deposit of clay is adjacent to the plant and limestone will be brought in from a high grade deposit in the Crow's Nest Pass of the Canadian Pacific Railway.

The mill of the Edmonton Portland Cement Company, Limited, at Marlboro, is the only one in the west operating on marl. The raw materials that form the supply for this plant consist of a large bed of marl at which the mill site is located and a deposit of blue clay five miles east of the marl bed. Capacity of mill 1,500 barrels. Coal is used for fuel.

The plant at Blairmore is operated by the Rocky Mountains Cement Company, Limited. High grade limestone is obtained close to the plant, as is also the shale used. Coal is used for fuel. Capacity of plant 800 barrels a day.

In the four Alberta mills, one (that of the Edmonton Portland Cement Company) uses the wet process, while the other three operate on the dry.

OIL AND GAS

Extensive oil and gas deposits have been found to exist throughout a large portion of Southern Alberta from the foot hills west of Calgary to the boundary line of the province east of Medicine Hat. The gas has been developed on a commercial scale at a number of points, particularly in the neighborhood of Medicine Hat and Bow Island. The supply for the City of Calgary is piped from the latter point. The gas has a high heat value (1,000 B.T.U. per cu. ft.) and makes a good fuel. During the past two years considerable prospecting for oil has been in progress with encouraging results. Oil has been found in several wells but not enough development has yet been done to determine the quantity or extent of its occurance.